

Claims:

1. An apparatus for separating one or more different-sequence polynucleotides from a polynucleotide mixture, comprising:

(a) a flow path,

(b) a plurality of solid supports which are disposed in series in the flow path, each support having bound thereto a sequence-specific capture agent that is complementary to a different-sequence target that may be present in the polynucleotide mixture, and

(c) a control mechanism in communication with the supports for altering a physical property of each support, separately from the other supports, between a target-binding state and a target-nonbinding state,

whereby (i) passage of such a mixture through the plurality of solid supports is effective to specifically bind different-sequence targets to a complementary capture agent on each support when the supports are each in a target-binding state, (ii) alteration of a physical property of a first selected support to a target-non-binding state is effective to release bound polynucleotides from that support, (iii) the polynucleotides released thereby can be eluted from that support by passage of a liquid medium through the flow path while polynucleotides captured on the other supports remain bound to those supports, and (iv) bound polynucleotides on the remaining supports can be released and eluted separately by repetition of steps (ii) and (iii) on the remaining supports.

2. The apparatus of claim 1, wherein the control mechanism is capable of performing steps (ii) and (iii) simultaneously.

3. The apparatus of claim 1, wherein the physical property is temperature, and the control mechanism comprises a temperature control element for selectively heating a selected support to release polynucleotides from that support.

4. The apparatus of claim 1, wherein the control mechanism comprises a plurality of heating elements, one for each support, and is operable to activate the heating elements to release polynucleotides from one support at a time.

5. The apparatus of claim 1, wherein the physical property is voltage potential, and the control mechanism comprises a voltage control element for setting individual electrical potentials of the solid supports to release polynucleotides from that support.

6. The apparatus of claim 1, wherein each support comprises a frits, bead, or powder cluster.

5 7. The apparatus of claim 1, comprising a processor in communication with the control mechanism for controlling the functions of the control mechanism.

8. The apparatus of claim 7, wherein the processor executes a program of instructions to control the functions of the control mechanism.

10 9. The apparatus of claim 8, wherein the program of instructions are conveyed to the processor by a processor-readable medium.

10. A method for isolating one or more different-sequence polynucleotides from a mixture, the method comprising:

(a) flowing the mixture through a flow path containing a plurality of solid supports which are located in series in the flow path, each support having bound thereto a sequence-specific capture agent complementary to a different-sequence polynucleotide, under conditions effective to specifically bind different-sequence polynucleotides to corresponding sequence-specific capture agents on one or more of the supports,

20 (b) after said specific binding, releasing bound polynucleotides from a selected support by altering a physical property of that support while leaving unaltered the same physical property of at least one other of the supports,

(c) eluting the released polynucleotides through the flow path such that the eluted polynucleotides can be isolated in separated form.

25 11. The method of claim 10, wherein the physical property is temperature.

30 12. The method of claim 11, wherein said releasing is accomplished by heating a first solid support while the temperatures of the other supports in the plurality of supports remain unchanged, such that polynucleotides are specifically eluted from the first solid support and are isolated in separated form.

13. The method of claim 12, wherein said altering further comprises selectively heating a second solid support to release bound polynucleotides therefrom, to allow preferential elution of the polynucleotides released from the second solid support.

5 14. The method of claim 13, wherein heating of the first and second supports is performed simultaneously, and the polynucleotides released thereby are eluted in separate form, without mixing with each other.

15. The method of claim 10, wherein the physical property is voltage potential.

10 16. The method of claim 10, wherein (i) the polynucleotide mixture comprises a plurality of different polynucleotide populations, each different polynucleotide population comprising a plurality of different polynucleotides that contain a distinct sequence associated with that population, and (ii) different sequence-specific capture agents on the different solid supports are complementary to different polynucleotide populations in the mixture.

17. The method of claim 10, wherein the polynucleotide mixture comprises a plurality of sequencing ladders.

18. The method of claim 10, wherein the polynucleotide mixture comprises a plurality of PCR products.

19. The method of claim 10, wherein the polynucleotide mixture comprises a plurality of ligation products.

20. The method of claim 10, wherein the different-sequence polynucleotides in the mixture include recovery tags for which the capture agents are complementary.